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Description of two new Australian genera of Megastigmidae (Hymenoptera, Chalcidoidea) with notes on the biology of the genus *Bortesia*

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Abstract

Two new genera, *Striastigmus*, **gen. nov.**, and *Vitreostigmus*, **gen. nov.**, as well as three new species, *S. bicoloratus*, **sp. nov.**, *V. maculatus*, **sp. nov.**, and *V. kangarooislandi*, **sp. nov.**, are described from Australia. A key to species of *Vitreostigmus* is provided as well as new information on the biology of genus *Bortesia*. Potential hosts of the newly described genera are discussed.

Keywords

Casuarinaceae, gall, *Hakea*, parasitoid, phytophagous

Introduction

While Parasitoida (*sensu* Peters et al. 2017) are mostly parasitic in habit, several lineages have returned, at least partly, to the ancestral phytophagy of Hymenoptera. Examples include the well-known gall-making Cynipidae (Blaimer et al. 2020) as well as a few lesser known cases within the Braconidae (e.g., Flores et al. 2005; Zaldívar-Riverón et al. 2014). Secondary phytophagy has evolved multiple times within Chalcidoidea (La

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Salle 2005) where it occurs in various ways such as seed-eating (e.g., Eulophidae, Eurytomidae), stem-boring (Eurytomidae), gall-making (e.g., Agaonidae, Tanaostigmatidae, Eulophidae, Pteromalidae), inquilinism (e.g., Eulophidae, Eurytomidae), and entomophytophagy (Eurytomidae, Ormyridae) (see Table 1).

Several of these strategies, together with parasitoidism, are also present in Megastigmidae (Grissell 1999) which makes the family remarkable among Hymenoptera for the diversity of its feeding strategies (Bouček 1988; Grissell 1995; Janšta et al. 2018). Megastigmidae includes parasitoids of various gall-making Diptera (mainly Cecidomyiidae), such as *Mangostigmus* Bouček, *Megastigmus* Dalman and *Neomegastigmus* Girault, and of gall-making Hymenoptera (mainly Cynipidae and Chalcidoidea) such as *Bootanomyia* Girault and *Megastigmus*. It also contains several species with strictly phytophagous larvae (*Bootanelleus* Girault, *Bootania* Dalla Torre, *Bortesia* Pagliano and Scaramozzino, *Megastigmus*, and *Macrodasyceras* Kamijo). Several families of numerous species of Gymnosperms (mostly conifers) and Angiosperms serve as the host of either gall-makers, such as *Bortesia*, or seed-feeders (Bouček 1988; Grissell 1999; Roques et al. 2016; Le et al. 2020). Holarctic species of the richest genus *Megastigmus* that develop in seeds, especially of conifers, are sometimes considered important economic pests (Roques and Skrzypczyńska 2003; Auger-Rozenberg and Roques 2012).

So far, only one genus of Megastigmidae, the genus *Bortesia*, has been shown to be a gall-maker. *Bortesia* occurs in Australia and comprises three species – *B. longistigmus* Riek, *B. mirostigmus* Riek and *B. similis* Riek. However, our knowledge of their biology is relatively limited (Riek 1966). According to Riek (1966), *Bortesia* develops in bud galls of several species of *Hakea* H. Schrader and J. C. Wendland (Proteaceae). *Bortesia*

Table 1. Summary of secondary phytophagous strategies in Chalcidoidea.

Family	Feeding strategy	Reference
Agaonidae	gall-making (Agaoninae, Sycophaginae)	(Cook and Rasplus 2003)
Eulophidae	seed-feeding (Tetrastichinae)	(La Salle 2005)
	gall-making (Opheliminae, Tetrastichinae)	(La Salle 2005; Reghunath and Raju 2020)
	seed-feeding (Entedoninae)	(Rasplus 1990)
	inquilinism (Tetrastichinae)	(La Salle 2005)
Eurytomidae	seed-feeding	(Zerova and Fursov 1991)
	stem-boring	(Zerova 1994; La Salle 2005)
	gall-making	(La Salle 2005)
	inquilinism	(La Salle 2005)
	entomophytophagy	(Zerova and Fursov 1991)
Megastigmidae	seed-feeding	(Grissell 1999)
	gall-making	(Riek 1966)
Ormyridae	entomophytophagy	(Gómez et al. 2017)
Pteromalidae	gall-making (Epichrysomallinae, Melanosomellini, Otitesellinae, Sycoecinae, Austrosystasinae, Miscogasterinae, Ormocerinae)	(Bouček 1988; Askew and Blasco-Zumeta 1997; Cook and Rasplus 2003; La Salle 2005)
	inquilinism (Sycoryctinae)	(Cook and Rasplus 2003)
Tanaostigmatidae	seed-feeding	(Lateef and Reed 1985)
	gall-making	(La Salle 2005)
	inquilinism	(La Salle 2005)
Tetracampidae	gall-making (Mongolocampinae)	(Sugonjaev and Voinovich 2003)
Torymidae	seed-feeding	(Bouček 1988)

longistigmus was reared from a bud gall on *H. dactyloides* (J. Gaertner) A. J. Cavanilles, *B. mirostigmus* from bud galls on *H. dactyloides* and from the stigma [probably part of the pistil] or bud galls on *H. teretifolia* J. Britten, and *B. similis* from "pineapple" bud-galls on *H. leucoptera* R. Brown. Since then, no update or specification of the biology of *Bortesia* has been recorded.

Megastigmidae comprises over 200 species currently classified in 12 valid genera (Janšta et al. 2018; Noyes 2019). The family is generally considered to have a worldwide distribution, however, its specific and generic richness occurs in the Australian biogeographical region. *Megastigmus* is the only cosmopolitan genus of the family, and is mostly diversified throughout the Holarctic region (Bouček 1988; Grissell 1999).

In this paper, we describe two new genera of Australian Megastigmidae. As one of these genera is morphologically similar to *Bortesia*, we also provide information on how these two genera can be recognized and add some new findings about the biology of *Bortesia* species.

Materials and methods

Specimens of *Striastigmus*, *Vitreostigmus* spp., *Bortesia mirostigmus* and some of *B. similis* were swept in different Australian localities (for details see respective species). A majority of our specimens of *B. similis* were reared from buds, leaves and twigs of *Hakea rostrata* (Böhmová and Janšta, pers. obs.). *Hakea* parts were stored in sealed plastic bags at room temperature and checked every two days. All specimens, both emerged and swept, were stored in 96% EtOH.

DNA of some specimens (those labeled as JRAS or JBOH) were extracted using the Qiagen DNeasy kit following the manufacturer's protocol and were subsequently sequenced for the COI (barcode fragment) following Cruaud et al. (2010) or ultra-conserved elements (UCE) following Cruaud et al. (2021). All COI sequences are deposited at NCBI under the accession numbers: ON007286–88.

High resolution images and some measurements of specimens were taken using a Keyence VHX 5000 digital microscope. For general observation and other measurements, a Leica M205C stereomiscrocope was used. Terminology of morphological structures in this study mostly follows Burks et al. (unpubl.), Gibson et al. (1997), and Janšta et al. (2020). Terms for surface sculpture follow Steinmann and Zombori (1985). Abbreviations of used morphological characters are: **F1–F7** = funicular 1–7; **Gt1–Gt4** = gastral terga; **POD** = posterior ocellus longest diameter, dorsal view; **OOL** = shortest distance between posterior ocellus and eye margin, dorsal view; **POL** = posterior ocellus longest diameter, dorsal view; **MPS** = multiporous plate sensilla; **OI** = ovipositor index, i.e., the ratio of ovipositor length to metatibia length.

Institutional abbreviations are: Charles University, Faculty of Science, Department of Zoology, Prague, Czech Republic (**CUPC**); Centre de Biologie

pour la Gestion des Populations, Montferrier-sur-Lez, France (**CBGP**); Queensland Museum, Brisbane, Australia (**QMB**); South Australian Museum, Adelaide, Australia (**SAMA**).

Results

***Striastigmus* Rasplus, Böhmová & Janšta, gen. nov.**
http://zoobank.org/b00dd03f-2562-477c-a3be-115ca5213c44
Fig. 1A–G

Type species. *Striastigmus bicoloratus* Rasplus, Böhmová & Janšta, sp. nov., by present designation.

Etymology. The generic name is composed of the Latin prefix *stria*, referring to the dense striation covering most of the body and *stigmus* referring to the large stigma of Megastigmidae. Masculine gender.

Diagnosis. Recognized from other Megastigmidae by having circular head shape with concentric striated sculpture on most of face (Fig. 1D). Toruli situated low on head with lower margin slightly above lower margin of eyes (Fig. 1D). Scrobes shallow, smooth and narrowly triangular, not reaching median ocellus (Fig. 1D). Most setation on upper face long and black, shorter and white on lower face. Gena smooth and shiny (Fig. 1C). Occipital carina raised, sharp, its dorsal part reaching vertex (Fig. 1A). Antenna slightly clavate with a conspicuous micropilosity area on last clavomere (Fig. 1E). Pronotum elongated, collar margined and more than half as long as mesoscutum (Fig. 1B). Anterior half of collar with ten transverse carinae (Fig. 1B). Mesoscutum coarsely cross striated (Fig. 1B). Mesoscutellum delimited anterolaterally from mesoscutum and axillae by broad foveate-septated scutoscutellar sulcus separating axillae (Fig. 1B). Frenum coarsely reticulated, extending on about half length of mesoscutellum (Fig. 1B). Propodeum relatively long, area between spiracles coarsely cross striated in proximal part, striate in distal part of propodeum medially turning backwards to propodeal foramen (Fig. 1G). Mesosoma dorsally with scarce long black setae, three long white setae laterally on pronotal collar, one on mesoscutal lateral lobe and three smaller ones on axilla along scutoscutellar suture (Fig. 1B). Hind coxa bare dorsally. Fore wing with marginal vein about as long as postmarginal vein, stigma enlarged, ovoid, basal vein present (Fig. 1F). Petiole elongated, about 0.8× as long as propodeum (Fig. 1G). Metasoma, not including petiole, shorter than mesosoma, smooth or with traces of coriaceous sculpture laterally (Fig. 1A), Gt1–2 medially slightly emarginated. Ovipositor upturned and slightly longer than the entire metasoma (Fig. 1A).

In the key of Bouček (1988) *Striastigmus* goes to couplet 14 (page 120) but differs from *Paramegastigmus* Girault by having oval head with concentric striated sculpture on most of face, cross striated pronotum, mesonotum and propodeum, coarsely reticulated frenum, and bicolored petiole, mesoscutellum, metanotum and legs, as well as the bicolored setae on head and mesosoma.

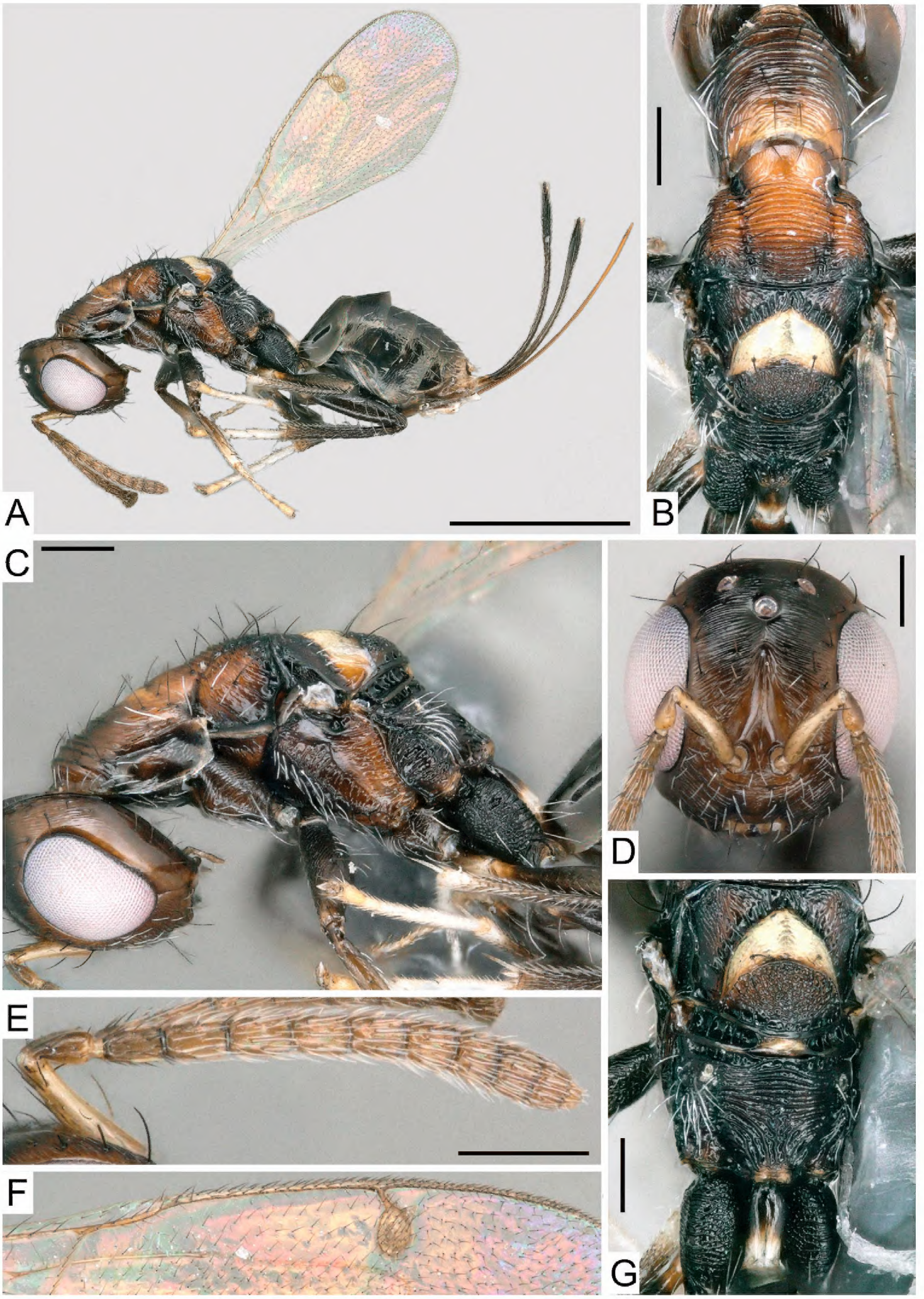

Figure 1. *Striastigmus bicoloratus* holotype, female **A** habitus, lateral view **B** mesosoma, dorsal view **C** head and mesosoma, lateral view **D** head, frontal view **E** antenna, lateral view **F** venation **G** propodeum, dorsal view. Scale bars: 200 μm except for habitus (1 mm).

Generic description. Female. Same as for description of *Striastigmus bicoloratus* Rasplus, Böhmová & Janšta, sp. nov.

Host association. Unknown. Swept from vegetation in rain forest.

Distribution. Australia: Queensland.

***Striastigmus bicoloratus* Rasplus, Böhmová & Janšta, sp. nov.**

http://zoobank.org/C7F53A6F-6F4A-4C85-91FA-C2DA1002BC70

Fig. 1A–G

Material examined. ***Holotype*:** Australia • ♀; Queensland, Wooroonooran NP, Palmerston section; 17.5896°S, 145.7042°E; 26 Nov. 2018; Cruaud A., Rasplus J.-Y. leg.; deposited in QMB (JRAS08291_0201).

Etymology. Species name refers to the bicolored petiole, mesoscutellum, metanotum and legs, as well as the bicolored setae on head and mesosoma.

Diagnosis. Same as for the genus.

Description. Female. ***Holotype.*** Body length excluding ovipositor 2.65 mm; length of ovipositor 1.30 mm. Color: Head, pronotum and mesonotum brown with upper face dorsally, lower face, vertex, lateral panel of pronotum, mesonotum distally, and lower mesepisternum dark brown to black. Axilla, foveate-septated line between axillae and mesoscutellum, frenum, lateral panel of metanotum, metapleuron and propodeum black to very dark brown. Mesoscutellum except frenum and marginal rim of mesoscutellum bright yellow. Axillula, metapleuron distally and adpetiolar stripe brownish. Antenna bright brown. Hind coxa and all femora and tibiae mostly black. Fore- and midtibiae apically, tibial spurs and tarsi pale yellow to white. Wings slightly infuscated with venation bright brown. Petiole bicolored, black in proximal part and pale yellow distally. Rest of metasoma and ovipositor sheath black except brown distalmost part of gaster and base of ovipositor sheath. Ovipositor stylet brown.

Head. Vertex and entire face with concentric striated sculpture except almost smooth scrobes and clypeus coriaceous medially; genae and temples smooth. Head circular frontally, 1.00× as broad as high; 1.44× as broad as long; 1.21× as broad as mesonotum at its widest part in dorsal view (Fig. 1C, D). Temples relatively long, 0.31× as long as eye (Fig. 1C). Eyes separated by 0.61× their own height; eye 1.60× as high as long. Scrobes shallow, in shape of elongated narrow triangle, its dorsal edge not reaching median ocellus; interantennal process inconspicuous, not reaching above dorsal edge of toruli. Vertex and upper face with sparse long black setation except a row of shorter bright brown to white setae along each side of scrobal cavity. Lower face striated, with short white setae except two setae on clypeus and two on lower face lateral to clypeus being about 2.00× longer than white ones, longer setae bright brown (Fig. 1D). Clypeus bilobed ventrally. Malar space 0.45× as long as breadth of oral fossa and 0.42× as long as eye height. Ocelli with POL 1.50× as long as OOL, OOL 1.25× as long as POD. Occipital carina distinct, with its dorsal margin on top of head; setation on occiput short and bright. Both mandibles with three teeth. Antenna (Fig. 1F) inserted very low on face, lower margin of toruli at level of lower eye margin. Scape short, reaching at most

dorsal margin of scrobes, 5.00× as long as broad. Pedicel 2.20× as long as broad. Combined length of pedicel and flagellum 1.37× as long as breadth of head. Anellus slightly transverse to quadrate, its breadth slightly narrower than F1 breadth. Relative length/breadth (ratio) of funiculars as follows: F1 16/10 (1.60), F2 19/10 (1.90), F3 19/10 (1.90), F4 17/10 (1.70), F5 16/10.5 (1.52), F6 15/11 (1.36), F7 14/13 (1.08). Clava with relative length/breadth (ratio) 30/16 (1.87); micropilosity area small on last claval segment. Setation of scape, pedicel and F1 dark, rest of flagellum bearing white setae.

Mesosoma. Setation of mesosoma as described above in the diagnosis. Mesosoma 2.53× as long as broad; pronotum 0.82× as broad as mesoscutum and about 1.13× as broad as long. Pronotum with pronotal collar delimited by transverse pronotal carina with 9 additional transverse carinae in its anterior half. Entire mesoscutum coarsely cross striated. Notauli well developed, foveate-septate, with row of setae along them. Mesoscutellum circular in dorsal view, 1.14× as long as broad; frenum densely reticulate and occupying half the length of mesoscutellum; frenum finely reticulate almost smooth; mesoscutellum with two pairs of setae, the first pair in anterior half and second pair on frenum (Fig. 1B). Propodeum (Fig. 1G) 1.72× as broad as long, area between spiracles coarsely cross striated in proximal part, striae in distal part of propodeum turning backwards medially to propodeal foramen; callus with long white setae; postspiracular furrow present. Supracoxal flange weakly developed. Metapleuron with no setae. Hind coxa rounded and bare dorsally, with transverse carinae dorsally, reticulated laterally. Metatibia with two spurs, shorter spur minute, about 0.2× as long as longer spur; longer spur shorter than basimetatarsus. Fore wing 2.60× as long as broad (Fig. 1A); clear with bright brown venation. Setae on disc dense and brown. Basal cell bare with basal setal line complete, basal vein weakly sclerotized but still visible. Marginal vein 1.14× as long as postmarginal vein and 3.23× as long as stigmal vein; stigma enlarged, ovoid, 1.46× as long as broad; uncus with 3 uncal sensilla.

Metasoma. Metasoma without ovipositor almost as long as mesosoma (Fig. 1A). Petiole about 0.80× as long as propodeum. Gastral tergites with shallow alutaceous sculpture; Gt1–Gt4 incised medially. Tip of hypopygium reaching to about 0.70× of length of gaster. Ovipositor upturned, about 1.25× as long as metasoma; OI 1.90.

Male. Unknown.

Biology. Unknown.

Distribution. Australia: Queensland, Wooroonooran NP.

Condition of the holotype. Holotype mounted on a rectangular card with left wings glued on a separate card. Very good condition, with legs, antennae and yellowish parts of the body slightly translucid due to DNA extraction and subsequent drying using HMDS (Heraty and Hawks 1998).

Vitreostigmus Böhmová & Janšta, gen. nov.

http://zoobank.org/2B9B9E87-25F7-470F-9445-8C4E568A7C06

Figs 2–5

Type species. *Vitreostigmus kangarooislandi* Böhmová and Janšta, by present designation.

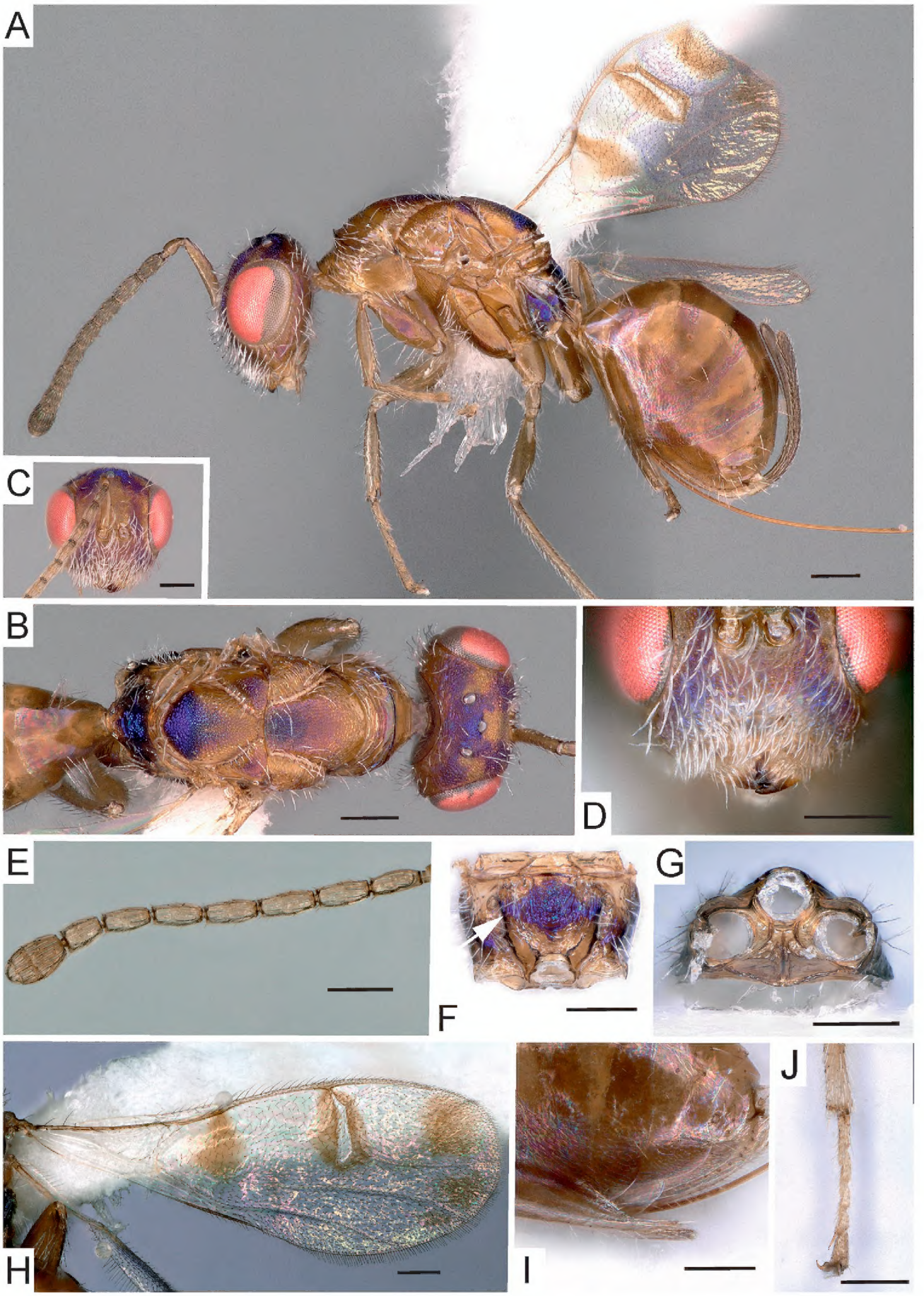

Figure 2. *Vitreostigmus maculatus* holotype, female **A** habitus, lateral view **B** head and mesosoma, dorsal view **C** head, frontal view **D** clypeus, frontal view **E** antenna, lateral view **F** propodeum, dorsal view (arrow indicates postspiracular furrow) **G** lower metepisternum, posteroventral view **H** fore wing, dorsal view **I** hypopygium, lateral view **J** posterior part of metatibia and metatarsi, lateroventral. Scale bars: 200 μm.

Etymology. Named after the transparent stigma which distinguishes the new genus from other genera of Megastigmidae. Masculine gender.

Diagnosis. *Vitreostigmus* can be distinguished from other genera of Megastigmidae by the following combination of characters: clypeus medially with one tooth (Fig. 3B); F1–F5 more than twice as long as broad; each flagellomere with two (in females) or three (in males) rows of MPS (Figs 2E, 3F, 5E); pronotal collar delimited by transverse pronotal carina and with some additional incomplete transverse striae (Figs 2B, 5D); mesoscutellum without frenal area, broadly touching transscutal articulation with small fovea separating disc of metascutellum from transscutal articulation (Figs 3E, 4B); propodeum long, about 0.50× as long as broad; postspiracular furrow well developed (Figs 2F, 3D); lower metepisternum with propodeal foramen oval, posteriorly narrower than anteriorly (pear-like shape); surface of lower metepisternum irregularly carinated, two additional carinae originate submedially from anterior margin of propodeal foramen, going forward in parallel and turning outwards to anterior margin of metacoxal foramen (Fig. 2G); fore wing with at least two infumations; stigma large, elongated, and transparent (Fig. 3G); tip of hypopygium reaching about 0.75× of length of gaster, but its tip narrow, fingerlike, projecting (Fig. 2I); ovipositor about 0.8× as long as metasoma (Figs 2A, 3A).

In the key of Bouček (1988) *Vitreostigmus* goes to couplet 19 (page 121) but differs from *Bortesia* by having, e.g., more intensive metallic color, pronotal collar carinated, long propodeum, and stigma transparent, and from *Bootanelleus* by having antennae inserted above lower margin of eye and stigma elongated and transparent and ovipositor shorter than metasoma.

Generic description. Female. Body length excluding ovipositor 2.12–2.66 mm; length of ovipositor 0.78–0.96 mm. Body light brown yellow. At least part of vertex, upper face, lower face laterally, posterior part of mesoscutal midlobe, posterior half of mesoscutellum, axilla, callus posterior to spiracle, propodeum and metapleuron blue green violet. Pronotal collar, lateral lobe of mesoscutum, lower mesepisternum, and metasomal tergites at least with weak violet tint. Fore wing with at least a brown macula under parastigma and around stigmal vein; submarginal vein light brown, marginal and postmarginal vein light brown yellow to white, stigmal vein translucent, sometimes appearing white.

Head. Vertex and at least upper face reticulate; malar space, temple, and gena coriaceous; occiput alutaceous. Temple 0.23–0.38× as long as eye. Eyes separated by 1.02–1.11× their own height, inner eye margins slightly diverging dorsally. Face with white setation; setae long and lanceolate, denser on lower face (Figs 2C, D, 3B). Scrobes shallow, not deeper than scape breadth, upper margin below imaginary line connecting dorsal margins of eyes; interantennal process reaching to about 0.33× of scrobes length. Clypeus delimited by weak sulcus laterally and posteriorly, medially with one tooth. Malar space 0.45–0.50× as long as breadth of oral fossa and 0.37–0.44× as long as eye height. Occipital carina present and well developed. Torulus inserted above ventral level of eye, but below centre of face. Anellus breadth slightly narrower than F1 breadth. F1–F5 more than twice as long as broad. Each segment with two rows of

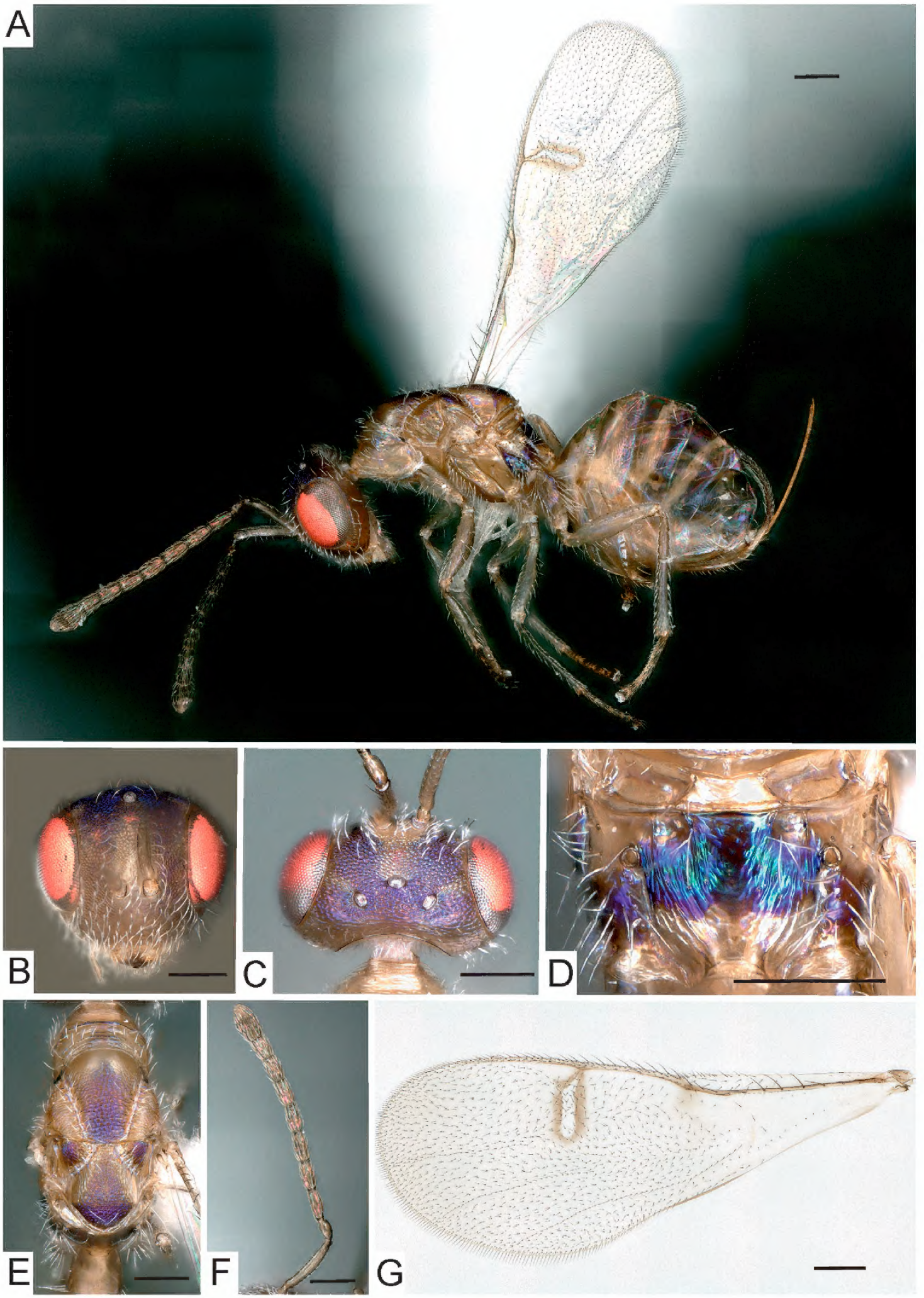

Figure 3. *Vitreostigmus kangarooislandi* holotype, female **A** habitus, lateral view **B** head, frontal view **C** head, dorsal view **D** propodeum, dorsal view **E** mesosoma, dorsal view **F** antenna **G** fore wing, dorsal view. Scale bars: 200 μm.

MPS; micropilosity area very small and restricted to third claval segment. First claval segment with two rows of MPS, the other two with one row of MPS. Ocelli small, POL 1.31–1.39× as long as OOL, OOL 1.68–2.25× as long as POD.

Mesosoma. Mesosoma 2.13–2.20× as long as broad, covered irregularly with sparse relatively long white setae dorsally. Pronotum 0.80–0.85× as broad as mesoscutum. Pronotum with pronotal collar well delimited by transverse pronotal carina; pronotal neck about as long as pronotal collar. Pronotal collar with some incomplete transverse striae. Mesoscutal midlobe reticulate with narrow smooth anterior part usually hidden under pronotal sclerite. Mesoscutal lateral lobes striate. Notauli well developed, foveated and whitish. Mesoscutellum with foveated marginal rim and without frenal area; anterior margin broadly touching transscutal articulation with small fovea separating disc of mesoscutellum from transscutal articulation; breadth of anterior mesoscutellar margin about half of posterior breadth of mesonotum. Mesoscutellum reticulate dorsally, with denser reticulation posteriorly, with two rows of several setae submedially. Axilla reticulate-striate. Scutoscutellar sulcus separating axillae foveate-septated. Propodeum long, about 0.50× as long as broad, irregularly longitudinally striate. Callus with smooth sculpture bearing long setation. Propodeal spiracle small and rounded, about 1.30× as far from anterior margin of propodeum as spiracle diameter. Postspiracular furrow developed as deep sulcus. Metacoxal flange developed as sharp flange. Lower metepisternum (Fig. 2G) with propodeal foramen oval, posteriorly narrower than anteriorly (broad pear-like shape), its anterior end below imaginary line drawn across posterior margin of metacoxal foramina; metacoxal foramina as far from each other as anterior diameter of propodeal foramen. Lower metepisternum anteriorly delimited by transverse concave carina connecting anterior margins of metacoxal foramina; medially carina rising in front of metafurcal pit. Surface of lower metepisternum with several irregular and incomplete transverse and longitudinal carinae; two additional carinae originate submedially from anterior margin of propodeal foramen, going forward in parallel and turning outwards to anterior margin of metacoxal foramen. Metatibia with two spurs, but shorter spur minute, about 0.33× as long as longer spur; longer spur shorter than basimetatarsus. Fore wing about 2.60× as long as wide, with infumation ventrad to parastigma and around stigmal vein; setae on disc dense and brown; speculum small reaching more or less only to end of parastigma; basal cell bare; basal setal line with a few setae dorsally; basal vein present but rudimentary, visible only as sclerotized fold in its posterior part; marginal vein 0.78–0.92× as long as postmarginal vein and 1.38–1.47× as long as stigmal vein; stigma large and elongated, 2.78–5.00× as long as broad; uncus with four uncal sensilla in row; venation pale brown, stigma vein posteriorly and stigma transparent (in some specimens white due to drying).

Metasoma. Petiole transverse, several times broader than long. Metasoma slightly longer than mesosoma. Gaster with very shallow alutaceous sculpture; Gt1–Gt4 incised medially; tip of hypopygium reaching about 0.66–0.75× of length of gaster, but its tip narrow, fingerlike, projecting. Ovipositor about 0.80× as long as metasoma.

Male. Only the male of *V. kangarooislandi* is known. Color and sculpture similar to females, sometimes more extensively metallic; antenna with scape shorter, hardly

reaching ventral margin of anterior ocellus; combined length of pedicel and flagellum about 2.5× as long as breadth of head; stigma large and broadly ovoid and brown; propodeum with irregular reticulate sculpture; all gastral tergites margins straight; funicular segments of the large male with three rows of MPS.

Comments. *Vitreostigmus* and *Bortesia* share several characters: single median tooth on clypeus, stigma lengthened in female, and ovipositor upturned and no longer than gaster (Riek 1966; Bouček 1988). However, *Bortesia* have the antennae inserted above the centre of face, a short pronotal collar which is bluntly angled (Fig. 6A), mesoscutellum anteriorly as broad as mid lobe of mesoscutum posteriorly, notauli almost meeting scutoscutellar sutures, and a short propodeum about 0.25× as long as broad and smooth to finely reticulate with no striae. Additionally, females of *Bortesia* have the stigma brown to bright brown (Fig. 6A, C), funiculars F2–F7 at most 2× as long as broad and bearing only one row of MPS (Fig. 6B). *Bortesia* females are non-metallic or at most with metallic hue while females of *Vitreostigmus* exhibit metallic coloration. In addition to the characters listed above, males of *Bortesia* differ from males of *Vitreostigmus* in exhibiting extensive metallic coloration (Fig. 6D, E), scape shorter than F1 (Fig. 6F), funicular segments flattened laterally, broadened and ventrally convex, and MPS partially sunken in funicular segments (Fig. 6G).

Key to species of *Vitreostigmus*

1 Lower face densely setose (Fig. 2C); scape shorter, only 5.56× as long as broad (Fig. 2A); F2–F4 more than 2.50× as long as broad; fore wing with five brown maculae, pear-like macula ventrad to parastigma, around stigmal vein and three brown maculae on tip of wing (Fig. 2H); stigma broadening in posterior half with tapering end; OI 1.14..... ***V. maculatus* sp. nov.**

– Lower face with sparser setation (Fig. 3B); scape longer, 5.71–5.86× as long as broad (Fig. 3F); at most F1 about 2.50× a long as broad; fore wing with two brown maculae, one ventrad to parastigma and one surrounding stigmal vein (Fig. 3G); stigma not broadening posteriorly; OI 1.25–1.34..... ..... ***V. kangarooislandi* sp. nov.**

***Vitreostigmus maculatus* Böhmová & Janšta, sp. nov.**
http://zoobank.org/C3EAA0EE-8D37-474B-868B-8CAF5DAD03A9
Fig. 2A–J

Material examined. ***Holotype*:** Australia • ♀; Queensland, Kirrama Barracks, Kirrama State Forest; 18°12'S, 145°45'E; 4 Jun. 1996; C. J. Burwell leg.; deposited in QMB (JBOH00033_0101).

Diagnosis. Head circular frontally (Fig. 2C); lower face with dense and long setation, setae adpressed and lanceolate (Fig. 2D); scape of antenna shorter, only 5.56× as long as broad; F2–F4 more than 2.5× as long as broad (Fig. 2E); mesoscutellum only

1.26× as long as broad (Fig. 2B); propodeum irregularly longitudinally striate (Fig. 2F); metatarsomere 4 (mtar4) with elongated unpaired spur-like seta, seta about as long as length of mtar4 (Fig. 2J); fore wing with five brown maculae, pear-like macula ventrad to parastigma, around stigmal vein and three brown maculae on tip of wing; stigma elongated, broadening in posterior half with tapering end (Fig. 2H); metasoma with tip of hypopygium reaching more than 0.75× of length of gaster (Fig. 2I); OI 1.14.

Description. Female. ***Holotype.*** Body length excluding ovipositor 2.47 mm; length of ovipositor 0.89 mm (Fig. 2A, B). Vertex except small area between lateral ocellus to upper eye margin and between median ocellus and scrobes, upper face between scrobes and inner eye margin, lower face laterally, posterior part of mesoscutal midlobe, posterior half to third of mesoscutellum, axilla, callus posterior to spiracle, anterior 0.66× of propodeum, and metapleuron blue violet. Supraclypeal area, clypeus, temple, pronotal collar, lateral lobe of mesoscutum, lower mesepisternum, fore coxa and femur, hind coxa and metasomal tergites laterally with violet tint. Fore wing transparent except brown pear-like macula under parastigma, broad brown macula surrounding stigmal vein and three brown maculae on tip of wing with anterior one the largest, posterior one smaller.

Head. Vertex and face reticulate. Head appearing circular from frontal view, vertex convex and median ocellus relatively high above upper eye margin; 1.14× as broad as high (Fig. 2C); 1.69× as broad as long; 1.35× as broad as mesonotum at its widest part in dorsal view. Temple short, converging, 0.23× as long as eye (Fig. 2B). Eyes separated by 1.02× their own height; eye 1.34× as high as long. Face setae adpressed; very dense on lower face so that clypeus surface not clearly visible (Fig. 2D); upper face with setae only along eye (one incomplete row) and scrobes (in about three rows) and few additional setae on vertex. Scrobes only slightly longer than half length of scape. Malar space 0.45× as long as breadth of oral fossa and 0.42× as long as eye height. Antenna (Fig. 2E) with scape 5.56× and pedicel 1.56× as long as broad, the former slightly curved in lateral view and reaching above dorsal margin of posterior ocellus. Combined length of pedicel and flagellum 1.87× as long as breadth of head. Anellus transverse. Relative length/breadth (ratio) of funiculars as follows: F1 22.5/10 (2.25), F2 24/9.5 (2.53), F3 25/9.5 (2.63), F4 24/9.5 (2.53), F5 22.5/9.5 (2.37), F6 21/9.5 (2.21), F7 19/11.5 (1.65). Clava with relative length/breadth (ratio) 30.5/15 (2.03). POL 1.35× as long as OOL, OOL 2.18× as long as POD. Left mandible with three teeth, right mandible denticulation hidden under left mandible.

Mesosoma. Mesosoma 2.13× as long as broad (Fig. 2B). Pronotum 0.85× as broad as mesoscutum. Pronotal collar about 3.09× as broad as long, with two incomplete but well raised transverse striae medially and with few additional incomplete lower striae laterally and lateromedially. Mesoscutellum 1.26× as long as broad, without frenal area, and with two rows of (probably) three setae submedially. Propodeum 2.20× as broad as long (Fig. 2F). Area between spiracles irregularly longitudinally striate; with few long white setae medially. Metacoxa 2.00× as long as broad, with long setation dorsally and ventrally; metafemur 4.50× as long as broad; metatibia 8.15× as long as broad; metatarsus relatively short, only 0.68× as long as metatibia. Metatarsomere 4

(mtar4) bearing elongated unpaired spur-like seta, seta about as long as length of mtar4 (Fig. 2J). Fore wing 2.63× as long as wide, slightly infumate ventral to parastigma and clear brown macula surrounding stigmal vein and three brown maculae on tip of wing (Fig. 2H); basal setal line complete, with several setae dorsally; mediocubital setal line with at least 3 setae dorsally in distal third; marginal vein 0.78× as long as postmarginal vein and 1.40× as long as stigmal vein; stigma broadening in posterior half with tapering end, 4.40× as long as broad; stigmal vein posteriorly and stigma transparent.

Metasoma. Metasoma 1.17× as long as mesosoma (Fig. 2A). Gaster not compressed laterally and with very shallow alutaceous sculpture; tip of hypopygium reaching more than 0.75× of length of gaster. Ovipositor upturned; OI 1.14.

Male. Unknown.

Etymology. Named after the distinctive brown maculae on fore wings.

Biology. Unknown.

Distribution. Australia: Queensland, Kirrama State forest.

Condition of the holotype. Unfortunately the unique specimen collected, the holotype female, was broken during imaging and several parts are now glued on three separate cards: one triangular card bears left fore and hind wing; a second triangular card with head including right scape, pedicel and annelus, part of mesosoma with right fore and hind wings and forelegs into one piece and mesophragma as a second piece; and a third rectangular card with right flagellum, metasoma, right mid leg, hind legs and posterior part of mesosoma including propodeum.

***Vitreostigmus kangarooislandi* Böhmová & Janšta, sp. nov.**

http://zoobank.org/0858BAAA-ED54-49B7-AFB2-C9BA18E7EB06

Figs 3A–G, 4A–D, 5A–I

Material examined. ***Holotype*:** Australia • ♀; South Australia, Kangaroo Island, Flinders Chase NP, Gosse lands; 35.93325°S, 136.9326°E; 16 Jan. 2019; P. Janšta, J. Böhmová leg., sweeping *Allocasuarina* sp.; deposited in SAMA (JBOH0037_0101); NCBI accession number ON007288. ***Paratypes*:** Australia • 3 ♀♀; same collection data as holotype; CUPC (JBOH0035_0101 (CUPC000156), CUPC000157 (NCBI accession number ON007286), CUPC000162) • 1 ♀; same collection data as holotype; SAMA (CUPC000159) • 2 ♀♀; same collection data as holotype; SAMA (CUPC000159, CUPC000161) • 1 ♂; same collection data as holotype; SAMA (CUPC000158); NCBI accession number ON007287 • 1 ♂; Kangaroo Island, near Seal Bay turning; 35.93253°S, 137.26188°E; 12 Jan. 2019; P. Janšta, J. Böhmová leg.; sweeping; CUPC (JBOH00013_0101 (CUPC000163)).

Diagnosis. Head slightly transverse frontally; lower face with long white setae, but setation not as dense as in *V. maculatus* (Fig. 3B); antenna with scape reaching dorsal margin of anterior ocellus, relatively longer, 5.71–5.86× as long as broad; anellus longer than broad; at most F1 about 2.50× a long as broad, other funiculars shorter (Fig. 3F); mesoscutellum 1.28–1.41× and propodeum 1.71–1.93× as broad as long

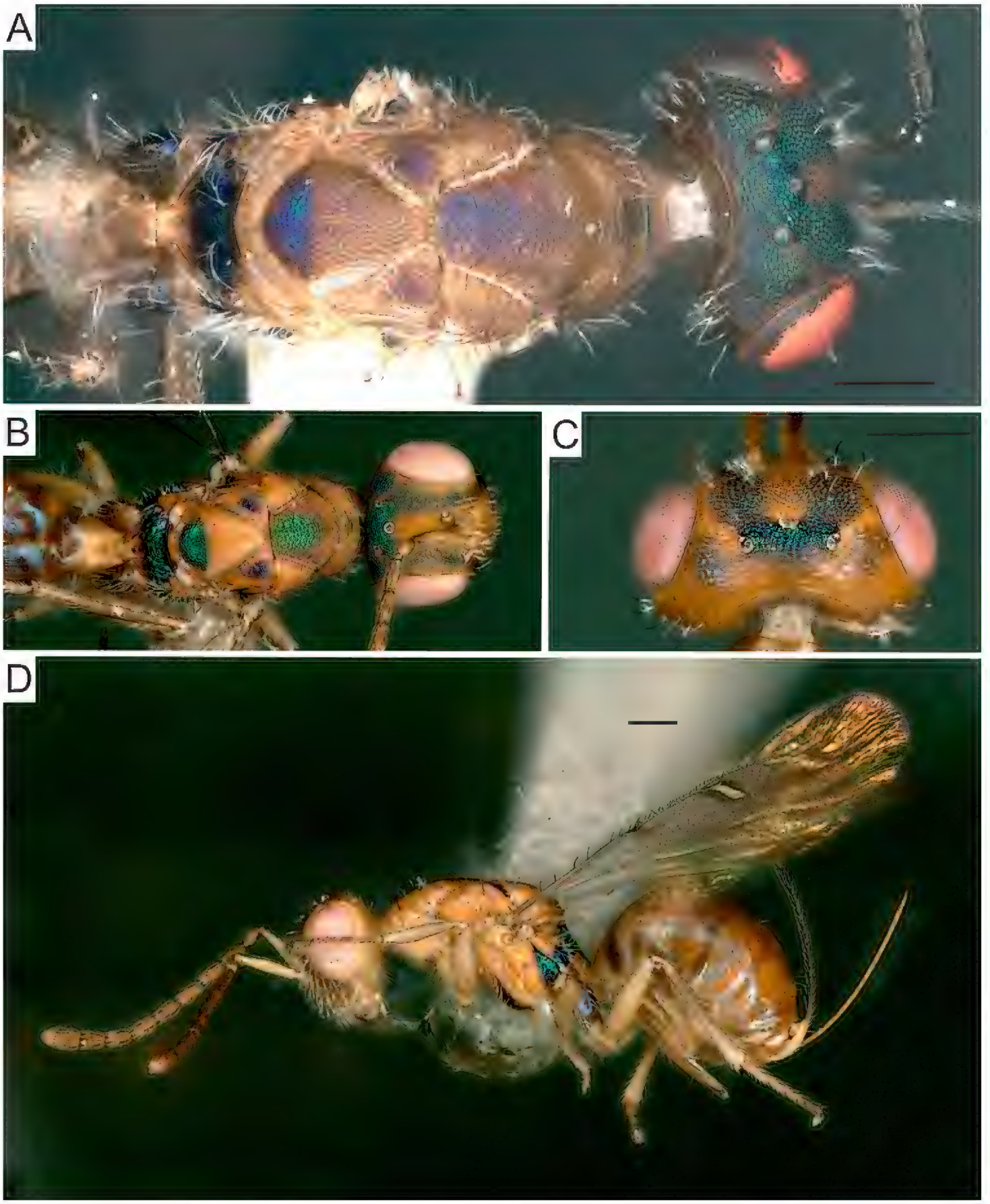

Figure 4. *Vitreostigmus kangarooislandi* paratypes females **A** head and mesosoma, dorsal view **B** head and mesosoma, dorsal view **C** head, dorsal view **D** habitus, lateral view. Scale bars: 200 μm.

(Fig. 3D, E); propodeum between spiracles with two smooth fovea anteriosubmedially delimited by striae on its each side, otherwise longitudinally striate (Fig. 3D); fore wing slightly obscured, with stronger infumation ventrad to parastigma and clear brown macula surrounding stigmal vein; stigma elongated, not broadening posteriorly, about 2.78–5.00× as long as broad (Fig. 3G); OI 1.25–1.34.

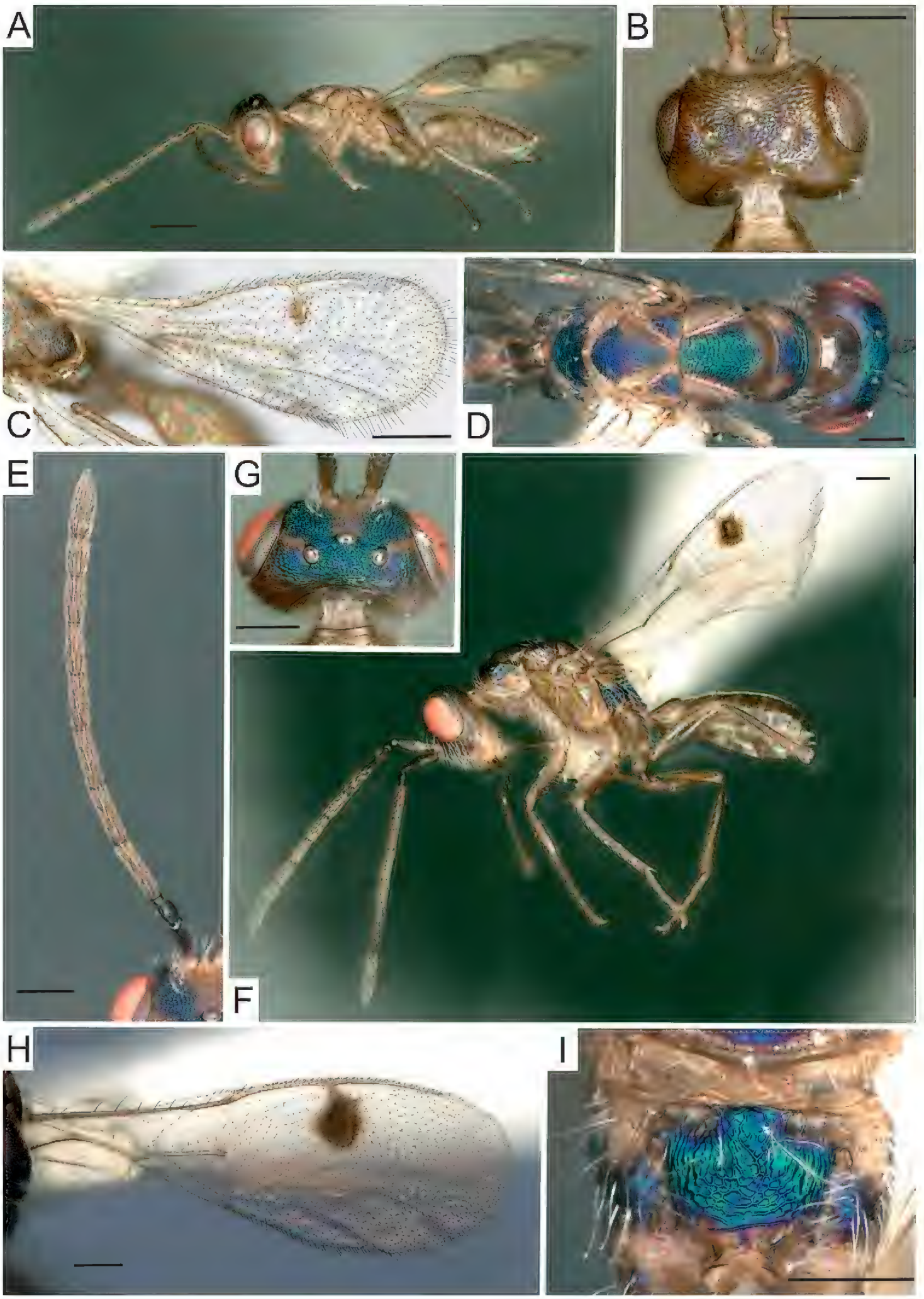

Figure 5. *Vitreostigmus kangarooislandi* paratypes, males **A** habitus, lateral view (CUPC000163) **B** head, dorsal view (CUPC000163) **C** fore wing, dorsal view (CUPC000163) **D** mesosoma, dorsal view (CUPC000158) **E** antenna (CUPC000158) **F** habitus, lateral view (CUPC000158) **G** head, dorsal view (CUPC000158) **H** fore wing, dorsal view (CUPC000158) **I** propodeum, dorsal view (CUPC000158). Scale bars: 200 μm.

Description. Female. Body length excluding ovipositor 2.12–2.66 mm [holotype = 2.33 mm]; length of ovipositor 0.78–0.96 mm [0.78 mm] (Fig. 3A). Most of vertex, upper face including area lateral to supraclypeal area and clypeus, most of mesoscutal midlobe, axilla, mesoscutellum, and callus posterior to spiracle violet. Metapleuron and anterior 0.66× of propodeum blue violet. Temple, lateral panel of pronotum, pronotal collar, mesoscutal lateral lobe, hind coxa dorsally and metasomal tergites with violet tint. Fore wing slightly obscured with stronger infumation under parastigma and clear brown macula surrounding stigmal vein.

Head. Vertex and upper face reticulate; clypeus and lower part of supraclypeal area smooth. Head slightly transverse, 1.12–1.19× [1.19] as broad as high (Fig. 3B); 1.81–1.96× [1.86] as broad as long; 1.34–1.46× [1.46] as broad as mesonotum at its widest part in dorsal view. Temple short, converging, 0.23–0.38× [0.26] as long as eye (Fig. 3C). Eyes separated by 1.02× their own height; eye 1.31–1.42× [1.42] as high as long. Upper face with only two rows of setae along eye and scrobes and few additional setae (2–3) between them. Malar space 0.45–0.50× [0.50] as long as breadth of oral fossa and 0.37–0.44× [0.39] as long as eye height. Antenna (Fig. 3F) with scape 5.71–5.86× [5.86] and pedicel 1.44–1.85× [1.50] as long as broad, the former reaching dorsal margin of anterior ocellus. Combined length of pedicel and flagellum 1.52–1.76× [1.75] as long as breadth of head. Anellus longer than broad, its breadth slightly narrower than F1 breadth. Relative length/breadth (ratio) of funiculars as follows: F1 2.06–2.53× [20/8 (2.50)], F2 2.10–2.38× [19/8 (2.38)], F3 2.25–2.44× [19/8 (2.38)], F4 2.10–2.22× [18/8 (2.25)], F5 2.10–2.2× [17.5/8.5 (2.06)], F6 1.81–1.82× [17/9 (1.89)], F7 1.40–1.57× [15/10 (1.50)]. Clava with relative length/breadth (ratio) 1.77–2.00× [26/15 (1.73)]. POL 1.31–1.39× [1.39] as long as OOL, OOL 2.20–2.67× [2.36] as long as POD. Each mandible with three teeth.

Mesosoma. Mesosoma about 2.20× as long as broad (Fig. 3E). Pronotum about 0.80× as broad as mesoscutum. Pronotum with pronotal collar about 2.90× as broad as long, with few transverse incomplete striae. Mesoscutellum 1.28–1.31× [1.41] as long as broad, with two rows of four setae submedially. Propodeum 1.71–1.93× [1.90] as broad as long (Fig. 3D). Area between spiracles with two small smooth areas anteriosubmedially delimited by striae on its each side, otherwise longitudinally striate; with few long white setae in proximal half. All legs relatively long and slender. Metacoxa about 2.65× as long as broad, with long setation dorsally and ventrally; metafemur about 4.75× as long as broad; metatibia about 7.83× as long as broad; metatarsus about 0.7× as long as metatibia. Fore wing 2.63–2.84× [2.63] as long as wide, slightly infumated, with stronger infumation ventrad to parastigma and clear brown macula surrounding stigmal vein (Fig. 3G); basal setal line with only three setae dorsally, mediocubital setal line bare dorsally and with about 8 setae ventrally in distal two thirds; marginal vein 0.85–0.92× [0.86] as long as postmarginal vein and 1.38–1.47× [1.41] as long as stigmal vein; stigma 2.78–5.00× [3.20] as long as broad; stigmal vein posteriorly and stigma transparent.

Metasoma. Metasoma about 1.05× as long as mesosoma. Gaster with very shallow alutaceous sculpture and in holotype female compressed laterally; tip of hypopygium reaching about 0.66–0.72× [0.67] length of gaster. OI 1.25–1.34 [1.27].

Female variability. Some specimens have vertex, upper face, most of mesoscutal midlobe, part of axilla, mesoscutellum in posterior third, metapleuron and anterior 0.66× of propodeum green blue; lower face including clypeus, temple, occiput close to occipital foramen and lower mesepimeron in its posterior half brownish with green, blue or violet tint (Fig. 4A–D). Marginal, postmarginal and stigmal veins after drying with HMDS tend to be bright yellow to white, and hence stigma not transparent.

Male. Length of body 1.40–2.59 mm. Our two males are quite different in metallic coloration The smaller one (CUPC000163) has vertex, mesoscutal midlobe distally, mesoscutellum, and median part of propodeum with a blue violet tint only; stigmal vein light brown, not translucent (Fig. 5A–C). The larger specimen (CUPC000158) is more intense metallic blue green as in most females having dorsal part of pronotal collar, mesoscutal midlobe, mesoscutellum and propodeum between spiracles largely blue green with violet reflection and stigma brown with brown surrounding infumation; antenna dark brown with slight metallic reflection except scape beneath (Fig. 5E–J). Other measurements similar to females except as follows: eyes separated by 1.14–1.36× their own height; eye 1.28–1.32× as high as long; malar space 0.44–0.48× as long as eye height; antenna with scape 3.8× as long as broad, hardly reaching ventral margin of anterior ocellus; combined length of pedicel and flagellum 2.40–2.58× as long as breadth of head; ocelli small, POL 1.50–1.61× as long as OOL, OOL 1.68–2.25× as long as POD; fore wing with marginal vein 0.71–0.87× as long as postmarginal vein and 1.56–2.15× as long as stigmal vein; stigma large and broadly ovoid but not elongated, 1.40–1.60× as long as broad; propodeum with irregular reticulate sculpture (Fig. 5I); all gastral tergite margins straight, not incised medially. Relative length/breadth of flagellar segments as follows: F1 3.75–4.30×, F2 3.33–3.68×, F3 3.06–3.33×, F4 2.72–3.11×, F5 2.66–2.89×, F6 2.29–2.50×, F7 1.77–2.18×, clava 2.50–3.69×. Funicular segments of the larger male have three rows of MPS, the smaller specimen has funicular segments only with two rows of MPS.

Etymology. Named after Kangaroo Island, the place of its discovery.

Biology. Unknown, probably associated with Casuarinaceae as some specimens were swept solely from *Allocasuarina* L. A. S. Johnson.

Condition of the holotype. Holotype mounted on a triangular card with no missing body parts. Metasoma is artificially laterally compressed due prior DNA isolation and subsequent drying using HMDS.

***Bortesia similis* (Riek, 1966)**

Figs 6A–G, 7A–B

Material. Australia • 1 ♀; South Australia, Mount Lofty; 34.97539°S, 138.70528°E; 21 Jan. 2019; P. Janšta, J. Böhmová leg.; sweeping *Hakea rostrata*; CUPC (JBOH0032_0101 (CUPC000164)) • 2 ♀♀; same collection data as for preceding; SAMA (CUPC000198–199) • 8 ♂♂; same collection data as for preceding; SAMA (CUPC000200–207) • 3 ♀♀; same collection data as for preceding; em.

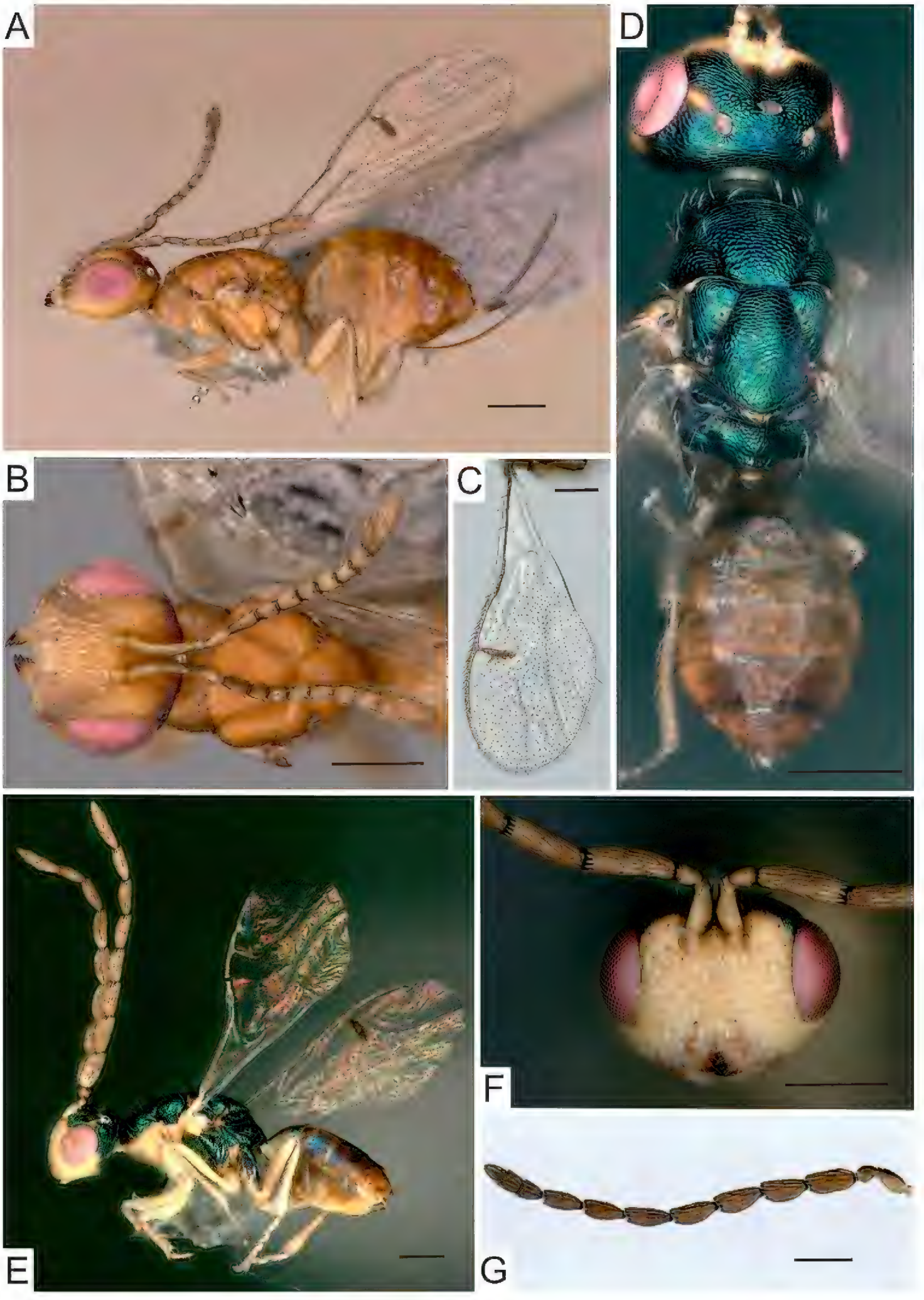

Figure 6. *Bortesia similis* **A** female habitus, lateral view **B** female head, antennae and mesosoma, frontal/dorsal view **C** female fore wing, dorsal view **D** male habitus, dorsal view **E** male habitus, lateral view **F** male head, frontal view **G** male antenna, lateral view. Scale bars: 200 μm.

from *Hakea rostrata* twigs (Jan.–Feb. 2019); CUPC (CUPC000165–166, 217) • 3 ♂♂; same collection data as for preceding; em. from *Hakea rostrata* twigs (Jan.–Feb. 2019); CUPC (CUPC000167–168, 218) • 1 ♀; same collection data as for preceding; em. from *Hakea rostrata* buds (Jan.–Feb. 2019); CUPC (CUPC000208) • 1 ♂; same collection data as for preceding; em. from *Hakea rostrata* buds (Jan.–Feb. 2019); CUPC (CUPC000209) • 8 ♀♀; same collection data as for preceding; 34.97538°S, 138.71064°E; 20 Jan. 2019; swept from *Hakea rostrata*; CUPC (CUPC000169–176) • 9 ♂♂; same collection data as for preceding; CUPC (CUPC000177–185) • 4 ♀♀; same collection data as for preceding; SAMA (CUPC000186–189) • 8 ♂♂; same collection data as for preceding; SAMA (CUPC000190–197) • 5 ♀♀; South Australia, Kangaroo Island, Flinders Chase NP, Gosse lands; 35.93625°S, 136.93204°E; 12 Jan. 2019; P. Janšta, J. Böhmová leg.; sweeping; CUPC (CUPC000210, 219–222).

Male recognition. We have reared and swept several males of *B. similis* during our survey in Mt. Lofty which is the first male record for this species. Face and dorsal thorax pilosity, sculpture of dorsal mesosoma and wing venation are similar to those of females (Fig. 6A–C). Males of *B. similis* can be easily recognized from males of *B. mirostigmus* by their coloration. They have the entire lower face, lower part of upper face, lateral panel of pronotum, prepectus, acropleuron, fore- and midlegs and hind femur, tibia and tarsi yellow. Upper part of upper face, rest of metasoma dorsally and laterally, and hind coxa are metallic green to blue green. Dorsal and lateral metasoma is brown to bright brown with blue green metallic reflections dorsally (Fig. 6D–G). In contrast, males of *B. mirostigmus* are darker with more extensive coloration (Riek 1966).

Distribution. Australia: NSW: Strahorn state forest (Riek 1966); SA: Adelaide, Mount Lofty; Kangaroo Isl. (**new records**).

Host. *Hakea leucoptera* (Riek 1966) and *H. rostrata* (**new record**).

Remarks on the biology of *B. similis*. While Riek (1966) reared *B. similis* from "pineapple" (bud) galls on *Hakea leucoptera*, we observed females of this species ovi-

Figure 7. *Hakea rostrata* with emergence holes of *Bortesia similis* **A** enlarged bud (indicated by arrow) **B** leaf (emergence hole indicated by arrow).

positing into the buds, but also into the twigs of *Hakea rostrata*. Subsequently, several specimens were reared from the twigs, leaves and slightly enlarged buds of *H. rostrata* (Fig. 7A) sampled in the same locality. The twigs and the leaves show no sign of swellings, but the leaves from which *Bortesia* emerged appeared to be dry apically (Fig. 7B).

Together with *Bortesia* specimens, we also reared several individuals of *Megastigmus* sp. from the sampled organs of *H. rostrata*. Because no native Australian species of *Megastigmus* is known to be a gall-maker or phytophagous on *Hakea*, and because no other insects emerged from our samples, we considered *Megastigmus* sp. to be a parasitoid of *B. similis*.

Bortesia mirostigmus (Riek, 1966)

Material. Australia • 3 ♀♀; South Australia, Kangaroo Island, Platypus Waterhole Walk; 35.93617°S, 136.72993°E; 14 Jan. 2019; Janšta, Böhmová leg.; sweeping of vegetation; CUPC (CUPC000211–212), SAMA (CUPC000213) • 3 ♂♂; same collection data as for preceding; CUPC (CUPC000214–215), SAMA (CUPC000216).

Distribution. Australia: NSW: Kariong (Riek 1966); WA: Perth, Scarborough; SA: Adelaide, Mount Lofty (Bouček 1988); Kangaroo Isl. (**new record**).

Host. *Hakea dactyloides*, *H. teretifolia*.

Biology. All specimens were swept on *Hakea* sp.

Discussion

In the last few years, we have carried out an extensive survey of the world Megastigmidae to reconstruct the first phylogeny of the family based on the sequencing of ultraconserved elements (UCE, Böhmová et al., in prep.). We conducted extensive sampling in Australia which enabled us to discover the two new genera described here. Consequently, the number of megastigmid genera is now raised to fourteen (Bouček 1988; Noyes 2019).

In non-oophagous species of Chalcidoidea, there is a global trend to associate metallic coloration and a parasitic way of life. Most larval or nymphal parasitoids appears to have metallic coloration (i.e., Pteromalidae, Eulophidae, Torymidae, Eupelmidae), even if some groups make exception (Leucospidae, Aphelinidae, most Chalcididae and Eurytomidae). Similarly, absence of metallic tinge is frequently associated with phytophagous habits. For example Agaonidae, Epichrysomallinae, Melanosomellini, Mongolocampinae or Anselmellini are all phytophagous and non-metallic, while their closer relatives are metallic and parasitoids. Within Megastigmidae, this trend was already discussed by Bouček (1988) who highlighted the association between metallic coloration and the parasitoid habits of Palaearctic *Bootanomyia* and to the opposite the non-metallic coloration of phytophagous *Megastigmus*.

This correlation, however, appears to be a rather poor predictor within Australasian Megastigmidae (Bouček 1988). While this appears to be true for *Bootanomyia* which

are mostly metallic and parasitic (Doğanlar 2011), *Bortesia*, which is also partly metallic, is phytophagous. In the same manner, Australian species of *Megastigmus* with no metallic coloration appear to be in fact parasitoids (where the biology has been thoroughly demonstrated) (Riek 1966; Grissell 1999).

Although we do not have information about the biology of the newly described taxa, we could possibly infer their potential biology from their closest relatives. Morphologically, *Vitreostigmus* appears closely related to *Bortesia*, *Bootanelleus* and *Ianistigmus*. These genera are characterized by a clypeus with a median tooth (Bouček 1988). As far as we know, males of all these genera all have long funicular segments bearing at least three rows of MPS, an unusual character within Megastigmidae (Bouček 1988). *Bortesia* (see above) and *Bootanelleus* are known to be phytophagous but the biology of *Ianistigmus* is still unknown. All specimens of *V. kangarooislandi* were swept from vegetation containing predominantly *Allocasuarina* sp. (Casuarinaceae), a member of the same plant family as *Casuarina* L., which is the host of the seed-eating *Bootanelleus orientalis* (Bouček 1988). Therefore, we hypothesize here that species of *Vitreostigmus* could be phytophagous as well.

Based on the bilobed clypeus, elongated pronotal collar, propodeum and petiole, *Striastigmus* appears closely related to *Paramegastigmus* (Bouček 1988). Unfortunately, the biology of *Paramegastigmus* is very poorly known. Bouček (1988) reported that *P. flavus* is associated with small leaf-galls on *Lophostemon* Schott (refered as *Tristania* R. Brown) species (Myrtaceae) and he observed both sexes of *P. flavus* swarming around galled leaves of *Lophostemon confertus* (R. Brown) Peter G. Wilson and J. T. Waterh (referred to as *Tristania conferta* R. Brown), without seeing any oviposition. From these observations, we expect that *Paramegastigmus* could be parasitic on some gall-makers. Therefore, we predict that *Striastigmus*, a close relative of *Paramegastigmus*, could be parasitic in habits.

This study highlights our lack of knowledge on Megastigmidae. Apart from a few *Megastigmus* species with economic importance, most other Megastigmidae are rather poorly studied in terms of taxonomy but also of biology. Out of the currently known 14 genera, we have fragmentary knowledge for only eight genera. Furthermore, for a majority of species, especially for the Australian members of the family, the biology still needs to be better documented.

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